EFFECT OF DRYING AND STORAGE ON THE CONTENT OF PROVITAMIN A OF ORANGE FLESHED SWEET POTATO *(Ipomoa batatas)*: DIRECT SUN RADIATIONS DO NOT HAVE SIGNIFICANT IMPACT

Bechoff, A.[1,2], Westby A.[1], Dufour, D.[2,3], Dhuique-Mayer, C.[2], Marouze, C.[2], Owori, C.[4], Menya, G.[4], and Tomlins, K.I.[1]

[1] Natural Resources Institute (NRI), University of Greenwich, Chatham ME44TB, United Kingdom
[2] Centre International de Recherche Agronomique pour le Développement (CIRAD) UMR Qualisud, Montpellier, France
[3] International Center for Tropical Agriculture (CIAT) , Cali, Colombia
[4] National Agricultural Research Organisation (NARO)-Kawanda Agricultural Research Institute, Kawanda, Uganda

Introduction

Sweetpotato is an important crop that is widely consumed in sub-Saharan Africa. Sun drying of sweetpotatoes is a traditional practice: after drying on rocks crushed or sliced dried sweetpotato are stored in granaries; re-hydrated and boiled to be eaten like fresh roots, or milled into flour to make porridge. Orange fleshed sweetpotato is being promoted in Africa to tackle vitamin A deficiency. There are inconsistent reports on the effect of sun-drying on pro-vitamin A retention. High losses have been reported which may be associated with the unsaturated instable provitamin A carotenoids easily degraded by light, oxygen and heat (Rodriguez Amaya 1997). This poster describes work to understand the effects of sun/solar drying and storage on pro-vitamin A retention.

Materials and methods

- **Samples**: Sweetpotato varieties from Uganda (produced by Namulongue Research Station NARO) and Mozambique (World Vision)
- **Dryers:** ***solar***: under clear plastic sheeting (greenhouse; tent or tunnel), ***sun***: direct exposition, ***shade***: under a roof made of straw. Chips were dried up to a moisture content of 7-10% wet basis.
- **Total carotenoids content** on sweetpotatoes grown in Uganda and Mozambica by visible spectrophotometry and **transβ-carotene content** by HPLC on preliminary samples (Orange Flesh Sweetpotato from USA). Samples were extracted in minimum triplicate. Readings were done at 450nm.
- **Losses** were calculated following the formula:

$$\text{total carotenoids (or all trans}\beta\text{-carotene loss (\%)} = 100 - 100 \times \frac{\text{total carotenoids (or all trans}\beta\text{-carotene) content in dried or stored chips (}\mu\text{g/g dry weight)}}{\text{total carotenoids (or all trans}\beta\text{-carotene) in fresh chips (}\mu\text{g/g dry weight)}}$$

- **Analysis of variance** SPSS14.0 software: Significant differences per variety between samples ($p<0.05$) were given by Tukey test and are indicated by different letters in the same column.

Results

Preliminary trials

Cross flow drying (hot air drying) significantly retained a higher content of all transβ-carotenes and total carotenoids than sun-drying. No significant difference was observed between drying by greenhouse solar dryer and direct sun in term of all transβ-carotene and total carotenoids (table 1). Total carotenoids content was significantly correlated to β-carotene content ($R=0.737$; $p<0.01$; 20 extractions) which indicated that total carotenoids can be used to estimate β-carotene content and pro-vitamin A. All transβ-carotene content represented 87% of total carotenoids.

Treatment (drying time)	Total carotenoids loss (%)**	All trans-β-carotene loss (%)***
Cross flow dried (2h)	13a	16a
Fan-operated greenhouse solar dried (8h)	21ab	23ab
Grated& sun dried (8h)	33b	34b

Table 1: Comparison of losses of total carotenoids and all trans-β-carotene on three dryers

Field trials

On both varieties grown in Uganda and Mozambique, no significant difference was observed between retention in solar (tunnel and/or tent) or sun dryer (tables 2&3). This differs from previous studies that reported sun drying was more damaging than solar drying (Rodriguez Amaya 1997, Mulokozi and Svanberg 2003).

Weather had a significant impact: average loss was 39% in wet weather against 4% in dry weather (table 2). There was a significant correlation between losses and drying time (Pearson coefficient $R=0.727$; $p<0.01$).

Weather		Dry		Wet/rainy	
Variety	Dryer	Drying time* (h)	Total carotenoids loss** (%)	Drying time*(h)	Total carotenoids loss** (%)
	Tent	23.5	2.5a	48.1	44.3a
Ejumula	Tunnel	5.7	6.3a	47.5	42.3a
	Sun	4.8	2.4a	45.7	38.3b
	Tent	24.6	6.6a	49.2	40.8a
Kakamega	Tunnel	5.7	6.8a	47.5	39.9a
	Sun	4.9	7.2a	45.7	35.7a

Table 2: Total carotenoids losses after drying in Uganda on two varieties of sweetpotato and two types of weather

Shade drying significantly retained more total carotenoids compared to sun and solar drying in Mozambique. Loss of provitamin A was even insignificant compared to fresh sweetpotatoes on MGCL (loss=-1.0%) (table 3).

Variety	Dryer	Drying time* (h)	Total carotenoids loss** (%)
MGCL	Tunnel	25.5	10.8a
	Sun	23.8	4.9a
	Shade	26.5	-1.0b
Resisto	Tunnel	26.1	14.6a
	Sun	25.4	16.5a
	Shade	50.7	7.7b

Table 3: Total carotenoids losses after drying in Mozambique on two varieties of sweetpotato in dry weather

Dried chips stored for 4 months had important losses for both varieties Ejumula and Kakamega with an average of 67%. Clear polythene bags placed under the window did not demonstrate any difference to opaque (black bag) sealed or with simple knot. Overall losses were of 78% (table 4). Some other studies on storage showed that light did not have such an important impact compared to other factors such as presence of oxygen.

Variety	Packaging	Total carotenoids loss (%)	Overall carotenoids loss (drying+storage%)
Ejumula	Sealed clear-PE bag in black PE bag	67.4a	79.9
	Black-PE bag with simple knot	70.5a	81.8
	Sealed clear-PE bag under window	64.7a	78.3
Kakamega	Sealed clear-PE bag in black PE bag	64.5a	77.2
	Black-PE bag with simple knot	62.4a	75.8
	Sealed clear-PE bag under window	63.4a	76.5

Table 4: Total carotenoids losses in Uganda on two varieties of sweetpotato stored for 125 days (4 months) in clear or black (opaque) polythene

Variety	Country	Flesh colour	Total carotenoids content (µg/g dwb)**	Estimated average vitamin A activity (RE)*
Kakamega	Uganda	Yellow-pale orange	92.3±2.7	568
MGCL	Mozambique	Pale orange	223.4±4.5	1375
Ejumula	Uganda	Orange	287.1±5.7	1767
Resisto	Mozambique	Deep orange	377.2±5.6	2321

Table 5: Flesh colour, total carotenoids and estimated vitamin A activity for dried chips from varieties analysed. 1 RE=13 µg β-carotene (Haskell et al. 2004). Daily Recommended Nutritional Requirement is 400 RE for a 2-5 year old child (FAO/WHO 2002). RE=Retinol Equivalent. β-carotene was estimated to 80% of total carotenoids for calculation.

Conclusions

❖ No significant difference was observed between the various solar dryers and sun dryer in terms of provitamin A retention: sun-drying can be recommended to farmers if the drying time is controlled.

❖ Shade drying significantly retained more total carotenoids than sun and solar drying but in some cases fermentation due to slower drying affected the chips quality.

❖ Losses are less than 40% in drying in general and less than 20% in dry weather in Uganda and Mozambique.

❖ On the other hand, losses after 4 month-storage are more than 60% independently of packaging (clear or opaque). Mechanisms of loss still need to be investigated.

❖ All dried chips met daily nutritional requirement for children (table 5). However further losses that occur during preparation of chips for consumption (Eg. 50% for the preparation of porridge) should be taken into account to measure estimated vitamin A activity in the consumer plate.

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Acknowledgments

The authors are grateful to HarvestPlus Challenge Programme as part of the "Reaching End Users in Uganda and Mozambique with OFSP" project for financial support. Preliminary work was financed by CIRAD Support to PhD students.

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